#4

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of	PCT/EP99/06960
Baltes GASS	Attorney Docket Q63642
Appln. No.: 09/812,568	Group Art Unit: not yet assigned
Confirmation No.: 2653	Examiner: not yet assigned

Filed: March 21, 2001

For: PROCESSING DEVICE AND PROCESSING TOOL FOR PROCESSING A WORKPIECE

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination, please amend the above-identified application as follows:

IN THE SPECIFICATION:

Please amend the specification as follows:

Page 3, amend the first three paragraphs as follows:

--As already mentioned, however, the body is not stationary in the process station, it instead being moved at a certain speed. This adds to the problem as explained above. For example, the operator may have already processed a few assembly sites on the next body, so that although the predefined number of bolting operations has been implemented, there is the problem of complete processing getting out of step and thus there is no longer the assurance that all bolts really have been tightened and/or with the corresponding torque/torsion angle (since there may be a change too, in the torque/torsion angle for each process operation and workpiece).

This is basically a problem since predefining the torque/torsion angle in conjunction with the number of process operations is independent of the location of the process tool, it depending solely on the sequence in processing or the predefined number of operations.

Prior Art

DE 36 37 236 C2 disclosing the preamble of claims 1, 15 assures correct processing to a certain extent by enabling various process operations differing in sequence to be implemented with the aid of a "smart" process tool without requiring the operator to make any changes to the control system or having to enter new data. The control and monitoring arrangement disclosed therein for a process tool, more particularly a screw driver or nut runner, comprises, as shown in Fig. 1a, an emitter 2 located in the process station 1 which emits a signal 3 in a restricted zone 6 which contains information explicitly identifying the corresponding process site 4 on the workpiece. As evident in Fig. 1b it is furthermore provided for that the complete process station 1 is divided into several zones 6a, 6b each having emitters 2a, 2b for each of the process sites 4a, 4b on the workpiece.

When a process tool 7 including a detector 2C applied thereto, as shown in Fig. 1c, is moved into the zone 6, 6a, 6b the detector 2c applied to the process tool 7 detects the corresponding signal 3 and the control and monitoring arrangement sets the torque provided for the process site 4, 4a, 4b. As evident from Fig. 1f when the recognizing means formed by the emitter and detector identifies the tool in a certain zone (process station), design process parameters are read by the programming means 8 from a memory 9 and output to the tool 7, whereby during processing a comparator 10 compares the actual values to the design values.

Page 4, after the first full paragraph insert the following:

--DE 197 23 365 A1 describes a method and a system for remachining a part in which the position of the tool is established by means of an emitter/detector assembly. More particularly, at least one emitter unit or detector unit is assigned to the workstation for emitting and detecting respectively signals to/from a detector unit or emitter unit assigned to the tool and connecting the processing means.

US 5,186,303 relates to a device for determining the location and orientation of an object on a substrate, more particularly the deviation from an ideal position. A CCD camera together with a pattern recognizing section is used to identify the actual position of a variable resistor or the like applied to the object.

DE 42 43 724 A1 discusses a method of positioning workpieces with the aid of a camera. The workpiece is positioned (translatory and/or rotationally) as desired with the aid of a camera, an image analyzer and a positioner in obtaining a plurality of typical images of the workpiece whilst being rotated and/or shifted translatory.--

Page 4, starting with the second full paragraph delete all the paragraphs in their entirety through to the last paragraph beginning at the bottom of page 7, ending at the top of page 8 and insert the following:

--Although, as already explained above currently available automated process tools permit processing with programmed process parameters, whereby by sensing the actual

parameters during processing it is also assured that the design process parameters are maintained, recognition can be implemented to "see" whether a process tool is located in a specific zone of the process station, there is nevertheless a requirement for a higher degree of process assurance to prevent an operator from working at wrong sites with unsuitable process parameters, due to a confusion in work schedules, for example.

It is thus the object of the present invention to sophisticate a process system and a process tool of the aforementioned kind so that it is assured that an operator actually undertakes processing at programmed process sites on the workpiece, independent of the location of the process tool in the process station.

Achievement of the object

This object is achieved by a process system as set forth in claim 1: in accordance with one aspect of this process system a recognizing means is provided which identifies each process site on the workpiece, and thus now there is no assignment of the process tool to a specific zone of the process station, instead the actual site to be processed by the process tool is identified. An operator is thus now free to implement the process operations in any sequence, the system always assuring that the operations predefined by the work schedule in the controller are implemented correctly sited.

The object is also achieved by a process system as set forth in claim 2. In accordance with one aspect of this process system a recognizing means is provided which identifies the location, i.e. the position of the process tool in the process station, the location, i.e. position of the workpiece in the process station and from which it is able to determine the location of the

process tool relative to the process site in each case. Once the location of the process tool and the location of the workpiece has been recognized then - since the process sites on the workpiece are always programmed (for example in a memory) - the system is always able to keep track of whether the process tool has been guided to the corresponding process site, also in the corresponding sequence, where several process sites are concerned, so that here too, the system is able to assign the process tool not, for example, to each zone, as in prior art, but to the process site itself. In other words, identifying the process site is implemented implicitly via locationing.

In accordance with a further aspect of the invention the recognizing means comprises a means for imaging at least one section of the workpiece in which at least one process site is located.

The imaging means may be preferably mounted on the tool or arranged integrally therein. Now, even if an operator moves the process tool anywhere in the process station, it is still assured that the work is done correctly sited, since the portion located ahead of the process tool is explicitly imaged. The imagings are then compared by an image processing means with predefined maps and programmed ting the process parameters is implemented on the basis of the imagings, thus assigning programmed ting of the process parameters explicitly to the imaged, i.e. recognized process site. Preferably the recognizing means comprises an image processing means and an image memory, the image processing means comparing a map imaged by the imaging means with programmed process site maps held in the image memory and outputs an identification signal in identifying a programmed process site to a process parameter programmed ting means when agreement between the imaged map and a memorized process site

map is established. Comparing the image data held in the image memory and the data imaged by the imaging means is preferably done with the aid of a logic, it being good practice to use fuzzy logic for the comparison to reduce the complication thereof.

In accordance with a further embodiment of the invention the imaging means is not applied to the process tool itself but at predefined locations in the process station so that at least part of the process station is imaged in which at least one workpiece is located. Thus, when the workpiece, for example, is moved at a predefined speed through the process station, a specific process site can now be identified. Preferably, the system recognizes whether processing has been done at the identified process site, i.e. when a process tool, likewise identified, is identified in the region of the process site. For identifying the process site and the process tool usual map recognition procedures may be employed.

Preferably the imaging means comprises a video camera or infrared camera. To also identify process sites at concealed or non-illuminated locations the process tool preferably comprises a light source for illuminating the process station or a part thereof ahead of the process tool.

Preferably an enabling means is provided which does not enable processing with the programmed process parameters until the recognizing means has identified a programmed process site. On the basis of the identified process sites a counter means can count how often, in accordance with a work schedule, a process site has been identified and how often processing with programmed process parameters has been implemented at this process site.

The process tool may be preferably a screw driver or nut runner. Preferably the process system comprises a means for sensing actual processing parameters and a means for comparing the sensed actual parameters to the design parameters for controlling the process tool so that in processing the actual parameter is brought into agreement with the design parameter.

In accordance with yet another aspect the process tool is provided with at least one marking and the recognizing means comprises an imaging means for imaging the process station, an image processing means identifying the location of the tool by processing the image of the marking and of the workpiece or at least part of the workpiece.

By means of predefined markings an image processing means is able to analyze movement maps of the process tool in establishing whether a predefined number of operations at each of the process sites has been implemented. More particularly the recognizing means is able to sense the speed at which the workpiece is moved on the basis of time-tracking the change in position of one or more process sites.

When a process tool is provided with several markings then the image processing means is also able to determine the angular orientation to the process site from analyzing the coordinates of both markings relative to the coordinates of the process sites or to a fixed system of coordinates.

Preferably the process tool comprises a set of process units in a predefined orientation. In this case a counter means of the recognizing means is able to enable the process tool at a subsequent process site only when the process tool, i.e. process units have assumed a plurality of

programmed locations relative to the process site, more particularly a predefined number of various angular orientations.

Preferably the recognizing means comprises a workpiece memory for memorizing workpiece data, the image processing means of the recognizing means determining the location (coordinates) of a reference coordinate point of the workpiece image and determines the location of the tool relative to the workpiece by analyzing the spacings between the coordinates of the marking and each process site with reference to the workpiece data held in the workpiece memory, more particulary relative to the data as to the location of the process sites. When the coordinates of the workpiece marking and those of a specific process site agree, or agree at least witin a tolerance range, then the system recognizes that processing is implemented at the corresponding location. On the basis of this recognition the tool can be enabled and/or the design values defined.--

Page 8, delete the paragraphs under the heading beginning with the second full paragraph through to the second paragraph of page 9 and insert the following:

--Further advantageous embodiments and improvements of the invention are set forth in the sub-claims. More particularly the invention comprises embodiments materializing from features claimed or described separately in the claims and subsequent description. The invention will now be detailled by way of its embodiments with reference to the drawing in which:

Figs. 1a-1e is a diagram of a prior art process system including a recognizing means for identifying a tool in a process station;

Fig. 2 is a block diagram of a process system in accordance with a first aspect of the invention;

Figs. 3a, 3b are diagrams of embodiments of a process tool including a recognizing means in accordance with a first aspect of the invention;

Fig. 4 is a diagram of an embodiment of the recognizing means including an imaging means 20a, an image memory 22 and an image processing means 21;--

Page 13, delete the paragraphs starting from the paragraph beginning at the bottom of the page through to the paragraph at the top of page 15 and insert the following:

--As explained at the outset, the process tool operator normally receives a work schedule so that a predefined number of process tools are first implemented e.g. with a M10 adapter bush and then with a M15 adapter bush in sequence. When using the imaging means in accordance with the invention in conjunction with a counter means it can also be assured that the predefined number of process operations has been implemented at the correct process sites, i.e. preventing the operator from attempting to bolt the same site twice whilst some other site is not processed at all. In other words, on the basis of the process site being identified the recognizing means is able to "see" that a process operation has already been successfully implemented at a specific process site, it being then, and only then, that the counter means considers the process operation (consisting of e.g. several individual bolting operations) to be concluded and resumes counting. If the operator attempts to reprocess the already finished process site, then the counter will not

recommence counting and preferably the enabling means will not re-enable the process tool at this process site.

Second Aspect of the Invention

Fig. 5 depicts a block diagram of a process system for processing a workpiece in accordance with a second aspect of the invention. Fig. 6 shows a view similar to that as shown in Fig. 3c in conjunction with the second aspect of the invention.

Referring now to Fig. 6 there is illustrated how in the second aspect of the invention too, a workpiece 5 is arranged in a programmed process station 1 and is processed at a plurality of process sites 4, 4` with programmed process parameters by at least one process tool 7, 7`. A recognizing means 200 is provided to identify the location and/or and angle orientation of the process tool 7, 7` in the process station 1, to identify the location of the workpiece 5 in the process station 1 and to determine therefrom the location of the process tool 7 relative to each process site 4. Once a predefined location of the workpiece (and/or a specific process site on the workpiece) relative to the tool has been recognized, the recognizing means 200 outputs the identification signal ES to the process parameter programming means 8 which, just the same as shown in Fig. 2, reads the corresponding design values from the memory means 9 for outputting to each process tool 7, 7` and to the comparator means 10. During processing , the comparator means 10 compares the actual values to the design values and controls the process tool 7 in the same way as shown in Fig. 2.--

Page 22, delete the first two paragraphs and insert the following:

--Accordingly, all embodiments of the first aspect and second aspect may be used in combination for enhanced process assurance. For example, the mounted or integrated imaging means may be used for recognizing difficult access process sites when in the second aspect of the invention the workpiece is not scanned from all sides by means of several imaging means.

Commercial Application

Although the first aspect and second aspect of the invention have been described with reference to an example in automobile production, it is understood that the process system and process tool in accordance with the invention are applicable to any kind of process operation on a workpiece.--

IN THE CLAIMS:

Please cancel claims 1-35 without prejudice or disclaimer.

Please add the following new claims:

--36. A process system including a process tool (7) for processing a workpiece (5) at a plurality of process sites (4) comprising:

a) a recognizing means (20) for identifying each process site (4) on said workpiece (5);

b) a means (8) for programming said process parameters on the basis of an identification signal (ES) characterizing each process site (4) and output by said recognizing means (20); whereby

c) said recognizing means (20) comprises

c1) an imaging means (20a) for imaging at least one section of said workpiece (5) in which at least one process site (4) is located;

c2) an image processing means (21); and

c3) an image memory (22); and whereby

d) said image processing means (21) compares a pixel map imaged by said imaging means (20a) with programmed process site pixel maps memorized in said image memory (22) and outputs said identification signal (ES) as to identification of a programmed process site when agreement is established between said imaged pixel map and a memorized pixel map of said process sites.

37. The process system as set forth in claim 36, characterized in that said imaging means (20a) is mounted on said tool (7).

38. The process system as set forth in claim 36, characterized in that said imaging means (20a) is arranged integrally in said tool (7).

39. The process system as set forth in claim 36, characterized in that said imaging means (20a) is arranged in said process station (1) and images at least part of said process station (1) in which at least one workpiece (5) is located.

40. The process system as set forth in claim 36, characterized in that said imaging means (20a) is a camera.

41. The process system as set forth in claim 40, characterized in that said camera is a video camera or an infrared camera.

42. The process system as set forth in claim 37, characterized in that said process tool (7) comprises a light source which illuminates said process station (1) or a part thereof ahead of said process tool (7).

43. The process system as set forth in claim 42, characterized in that said image processing means (21) compares said image data of said pixel map imaged by said imaging means (20a) to said image data of said pixel map memorized in said image memory (22) with the aid of a logic (FL).

44. The process system as set forth in claim 43, characterized in that said logic (FL) is a fuzzy logic.

45. The process system as set forth in claim 36, characterized in that said process tool (7) is a screw driver or nut runner and said process parameters programmed by said process parameter programming means (8) are a programmed torque and/or programmed torsion angle.

46. The process system as set forth in claim 36, characterized in that said workpiece (5) is a motor vehicle or part of a motor vehicle, said process site (4) being predefined assembly sites on said motor vehicle or on said part, said process station (1) being a predefined station of an assembly line and said process relates to assembling items to predefined assembly sites.

47. The process system as set forth in claim 36, characterized in that an enabling means is provided which does not enable processing by said process tool (7) with said programmed process parameters until said recognizing means (20) has identified a programmed process site (4).

48. The process system as set forth in claim 36, characterized by a counter means for counting how often said recognizing means (20) identifies a process site and how often processing by said process tool (7) with said preset process parameters is implemented at said process site (4).

49. The process system as set forth in claim 36 comprising a means for sensing actual parameters during said process operation at each process site (4) and a comparator means (10) for comparing said sensed actual process parameters to said design process parameters and for controlling said process tool (7) so that in said process operation said actual and said design process parameters are brought into agreement.

50. A system for processing a workpiece (5) located in a prodefined process station (1) at a plurality of process sites (4) with programmed process parameters, comprising at least one process tool (7) for processing said workpiece (5) at said programmed process sites (4) and a recognizing means (200) for identifying whether said process tool (7) is located in said process station (1),

characterized in that

said recognizing means 200 is designed

- to identify said location of said process tool (7) in said process station (1);
- to identify said location of said workpiece (5) in said process station (1); and
- to determine therefrom the location of said process tool (7) relative to each process site (4); whereby

said process tool (7) is provided with at least one marking (202) and

said recognizing means (200) comprises an imaging means (201) for imaging said process station (1) and at least a section of said workpiece (5), an image processing means (203) identifying the location of said process tool (7) relative to said workpiece (5) by processing the image of said at least one marking (202) and of said at least one section of said workpiece (5), and a means (7) for setting said tool (7) to said process parameters on the basis of the position of said process tool (7) relative to said process site (4).

51. The process system as set forth in claim 50, characterized in that said imaging processing means (203) analyze movement maps of said process tool (7) in establishing whether a predefined number of process operations at each of said process sites (4) has been implemented.

52. The process system as set forth in claim 50, characterized in that an enabling means does not enable said identified process tool (7) at a programmed process site (4") until said recognizing means (200) has identified a predefined number of process operations at a previous process site (4).

53. The process system as set forth in claim 50, characterized in that said recognizing means (200) senses the speed at which said workpiece (4) is moved on the basis of time-tracking the change in position of one or more process sites (4).

54. The process system as set forth in claim 50, characterized in that said recognizing means (200) identifies an angular orientation of said process tool (7) relative to a programmed process site (4).

55. The process system as set forth in claim 52, characterized in that said process tool (7) comprises a set of process units (71-74) including a predefined orientation, said enabling means enabling said process units at a subsequent process site only when a counter means of said recognizing means (200) has established that said process units (71-74) have assumed a predefined number of orientation locations at a previous process site.

56. The process system as set forth in claim 50, characterized in that said workpiece (5) is a motor vehicle or part of a motor vehicle, said process site (4) is a predefined assembly site on said motor vehicle or on said part, said process station (1) is a predefined station of a motor vehicle assembly line, said process tool (7) comprises one or more screw drivers or nut runners, and said programmed process parameters are bolting parameters of said one or more screw drivers or nut runners.

57. The process system as set forth in claim 56, characterized in that said bolting parameters comprise a torque and/or a torsion angle of said one or more screw drivers or nut runners.

58. The process system as set forth in claim 50, characterized in that said recognizing means (200) comprises a workpiece memory (204) for memorizing workpiece dimensions, said image processing means (204) determines the location of a reference coordinate point of said workpiece image (51) and determines the location of said tool marking (2902) in a system of coordinates (x, y) fixed relative to said process station (1) and determines by analyzing the spacings between said coordinates of said marking and each process site (4) with reference to said workpiece dimensions held in said workpiece memory (204).

59. The process system as set forth in claim 54, characterized in that said tool is provided with two markings (202, 202`) and said image processing means (203) determines said angular orientation of said tool relative to said process site (4) on the basis of analyzing said coordinates of both markings relative to said coordinates of said process sites (4).--

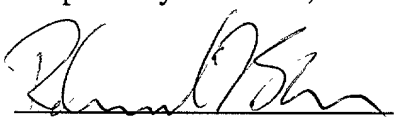
IN THE ABSTRACT:

Please insert the required Abstract of the Disclosure found on the attached unnumbered sheet.

REMARKS

Entry and consideration of this Amendment and an early and favorable action on the merits is respectfully requested.

Respectfully submitted,



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Date: November 29, 2001

APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The specification is changed as follows:

Page 3, amend the first three paragraphs as follows:

--As already mentioned, however, the body is not stationary in the process station, it instead being moved at a certain speed. This adds to the problem as explained above. For example, the operator may have already processed a few assembly sites on the next body, so that although the predefined number of bolting operations has been implemented, there is the problem of complete processing getting out of step and thus there is no longer the assurance that all bolts really have been tightened and/or with the corresponding torque/torsion angle (since there may be a change too, in the torque/torsion angle for each process operation and workpiece). This is basically a problem since ~~programming~~ predefining the torque/torsion angle in conjunction with the number of process operations is independent of the location of the process tool, it depending solely on the sequence in processing or the predefined number of operations.

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comprises, as shown in Fig. 1a, an emitter 2 located in the process station 1 which emits a signal 3 in a restricted zone 6 which contains information explicitly identifying the corresponding process site 4 on the workpiece. _As evident in Fig. 1b it is furthermore provided for that the complete process station 1 is divided into several zones 6a, 6b each having emitters 2a, 2b for each of the process sites 4a, 4b on the workpiece.

When a process tool 7 including a detector 2C applied thereto, as shown in Fig. 1c, is moved into the zone 6, 6a, 6b the detector 2c applied to the process tool 7 detects the corresponding signal 3 and the control and monitoring arrangement sets the torque ~~programmed~~ provided for the process site 4, 4a, 4b. _As evident from Fig. 1f when the recognizing means formed by the emitter and detector identifies the tool in a certain zone (process station), design process parameters are read by the programming means 8 from a memory 9 and output to the tool 7, whereby during processing a comparator 10 compares the actual values to the design values.

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It is thus the object of the present invention to sophisticate a process system and a process tool of the aforementioned kind so that it is assured that an operator actually undertakes

processing at programmed process sites on the workpiece, independent of the location of the process tool in the process station.

Achievement of the object

This object is achieved by a process system as set forth in claim 1: in accordance with one aspect of this process system a recognizing means is provided which identifies each process site on the workpiece, and thus now there is no assignment of the process tool to a specific zone of the process station, instead the actual site to be processed by the process tool is identified. An operator is thus now free to implement the process operations in any sequence, the system always assuring that the operations predefined by the work schedule in the controller are implemented correctly sited.

The object is also achieved by a process system as set forth in claim 2. In accordance with one aspect of this process system a recognizing means is provided which identifies the location, i.e. the position of the process tool in the process station, the location, i.e. position of the workpiece in the process station and from which it is able to determine the location of the process tool relative to the process site in each case. Once the location of the process tool and the location of the workpiece has been recognized then - since the process sites on the workpiece are always programmed (for example in a memory) - the system is always able to keep track of whether the process tool has been guided to the corresponding process site, also in the corresponding sequence, where several process sites are concerned, so that here too, the system is able to assign the process tool not, for example, to each zone, as in prior art, but to the process site itself. In other words, identifying the process site is implemented implicitly via locationing.

In accordance with a further aspect of the invention the recognizing means comprises a means for imaging at least one section of the workpiece in which at least one process site is located.

The imaging means may be preferably mounted on the tool or arranged integrally therein. Now, even if an operator moves the process tool anywhere in the process station, it is still assured that the work is done correctly sited, since the portion located ahead of the process tool is explicitly imaged. The imagings are then compared by an image processing means with predefined maps and programmed ting the process parameters is implemented on the basis of the imagings, thus assigning programmed ting of the process parameters explicitly to the imaged, i.e. recognized process site. Preferably the recognizing means comprises an image processing means and an image memory, the image processing means comparing a map imaged by the imaging means with programmed process site maps held in the image memory and outputs an identification signal in identifying a programmed process site to a process parameter programmed ting means when agreement between the imaged map and a memorized process site map is established. Comparing the image data held in the image memory and the data imaged by the imaging means is preferably done with the aid of a logic, it being good practice to use fuzzy logic for the comparison to reduce the complication thereof.

In accordance with a further embodiment of the invention the imaging means is not applied to the process tool itself but at predefined locations in the process station so that at least part of the process station is imaged in which at least one workpiece is located. Thus, when the workpiece, for example, is moved at a predefined speed through the process station, a specific

process site can now be identified. Preferably, the system recognizes whether processing has been done at the identified process site, i.e. when a process tool, likewise identified, is identified in the region of the process site. For identifying the process site and the process tool usual map recognition procedures may be employed.

Preferably the imaging means comprises a video camera or infrared camera. To also identify process sites at concealed or non-illuminated locations the process tool preferably comprises a light source for illuminating the process station or a part thereof ahead of the process tool.

Preferably an enabling means is provided which does not enable processing with the programmed process parameters until the recognizing means has identified a programmed process site. On the basis of the identified process sites a counter means can count how often, in accordance with a work schedule, a process site has been identified and how often processing with programmed process parameters has been implemented at this process site.

The process tool may be preferably a screw driver or nut runner. Preferably the process system comprises a means for sensing actual processing parameters and a means for comparing the sensed actual parameters to the design parameters for controlling the process tool so that in processing the actual parameter is brought into agreement with the design parameter.

In accordance with yet another aspect the process tool is provided with at least one marking and the recognizing means comprises an imaging means for imaging the process station, an image processing means identifying the location of the tool by processing the image of the marking and of the workpiece or at least part of the workpiece.

By means of predefined markings an image processing means is able to analyze movement maps of the process tool in establishing whether a predefined number of operations at each of the process sites has been implemented. More particularly the recognizing means is able to sense the speed at which the workpiece is moved on the basis of time-tracking the change in position of one or more process sites.

When a process tool is provided with several markings then the image processing means is also able to determine the angular orientation to the process site from analyzing the coordinates of both markings relative to the coordinates of the process sites or to a fixed system of coordinates.

Preferably the process tool comprises a set of process units in a predefined orientation. In this case a counter means of the recognizing means is able to enable the process tool at a subsequent process site only when the process tool, i.e. process units have assumed a plurality of programmed locations relative to the process site, more particularly a predefined number of various angular orientations.

Preferably the recognizing means comprises a workpiece memory for memorizing workpiece data, the image processing means of the recognizing means determining the location (coordinates) of a reference coordinate point of the workpiece image and determines the location of the tool relative to the workpiece by analyzing the spacings between the coordinates of the marking and each process site with reference to the workpiece data held in the workpiece memory, more particulary relative to the data as to the location of the process sites. When the coordinates of the workpiece marking and those of a specific process site agree, or agree at least

witin a tolerance range, then the system recognizes that processing is implemented at the corresponding location. On the basis of this recognition the tool can be enabled and/or the design values defined.--

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Fig. 4 is a diagram of an embodiment of the recognizing means including an imaging means 20a, an image memory 22 and an image processing means 21;--

Page 13, delete the paragraphs starting from the paragraph beginning at the bottom of the page through to the paragraph at the top of page 15 and insert the following:

--As explained at the outset, the process tool operator normally receives a work schedule so that a predefined number of process tools are first implemented e.g. with a M10 adapter bush and then with a M15 adapter bush in sequence. When using the imaging means in accordance with the invention in conjunction with a counter means it can also be assured that the predefined number of process operations has been implemented at the correct process sites, i.e. preventing the operator from attempting to bolt the same site twice whilst some other site is not processed at all. In other words, on the basis of the process site being identified the recognizing means is able to "see" that a process operation has already been successfully implemented at a specific process site, it being then, and only then, that the counter means considers the process operation (consisting of e.g. several individual bolting operations) to be concluded and resumes counting. If the operator attempts to reprocess the already finished process site, then the counter will not recommence counting and preferably the enabling means will not re-enable the process tool at this process site.

Second Aspect of the Invention

Fig. 5 depicts a block diagram of a process system for processing a workpiece in accordance with a second aspect of the invention. Fig. 6 shows a view similar to that as shown in Fig. 3c in conjunction with the second aspect of the invention.

Referring now to Fig. 6 there is illustrated how in the second aspect of the invention too, a workpiece 5 is arranged in a programmed process station 1 and is processed at a plurality of process sites 4, 4` with programmed process parameters by at least one process tool 7, 7`. A recognizing means 200 is provided to identify the location and/or and angle orientation of the

process tool 7, 7` in the process station 1, to identify the location of the workpiece 5 in the process station 1 and to determine therefrom the location of the process tool 7 relative to each process site 4. Once a predefined location of the workpiece (and/or a specific process site on the workpiece) relative to the tool has been recognized, the recognizing means 200 outputs the identification signal ES to the process parameter programming means 8 which, just the same as shown in Fig. 2, reads the corresponding design values from the memory means 9 for outputting to each process tool 7, 7` and to the comparator means 10. During processing , the comparator means 10 compares the actual values to the design values and controls the process tool 7 in the same way as shown in Fig. 2.--

Page 22, delete the first two paragraphs and insert the following:

--Accordingly, all embodiments of the first aspect and second aspect may be used in combination for enhanced process assurance. For example, the mounted or integrated imaging means may be used for recognizing difficult access process sites when in the second aspect of the invention the workpiece is not scanned from all sides by means of several imaging means.

Commercial Application

Although the first aspect and second aspect of the invention have been described with reference to an example in automobile production, it is understood that the process system and process tool in accordance with the invention are applicable to any kind of process operation on a workpiece.--

IN THE CLAIMS:

Claims 1-35 are canceled.

Claims 36-59 are added as new claims.

IN THE ABSTRACT OF DISCLOSURE:

The required Abstract has been added.